ECOSYSTEM STATUS INDICATORS
Physical Environment

GULF OF ALASKA
Eddies in the Gulf of Alaska – FOCI
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Eddies in the northern Gulf of Alaska have been shown to influence distributions of nutrients (Ladd et al. 2005) and phytoplankton biomass (Brickley and Thomas 2004) and the foraging patterns of fur seals (Ream et al. 2005). Eddies propagating along the slope in the northern and western Gulf of Alaska are generally formed in the eastern gulf in the autumn or early winter (Okkonen et al. 2001). In most years, these eddies impinge on the shelf east of Kodiak Island in the spring. Using altimetry data from 1993 to 2001, (Okkonen et al. 2003) found an eddy in that location in the spring of every year except 1998. They found that strong, persistent eddies occur more often after 1997 than in the period from 1993 to 1997.

Since 1992, the Topex/Poseidon/Jason/ERS satellite altimetry system has been monitoring sea surface height (SSH). Gridded altimetry data (merged TOPEX/Poseidon, ERS-1/2, Jason and Envisat; Ducet et al. 2000) allow the calculation of eddy kinetic energy (EKE). A map of eddy kinetic energy in the Gulf of Alaska averaged over the altimetry record shows three regions local maxima (labeled a, b, and c in Figure 12). The first two regions are associated with the formation of Haida eddies (a) and Sitka eddies (b). Regions of enhanced EKE emanating from the local maxima illustrate the propagation pathways of these eddies. Sitka eddies can propagate southwestward (directly into the basin) or northwestward (along the shelf break). The Sitka eddies that follow the northwestward path often feed into the third high EKE region (c; Figure 12). By averaging EKE over region c (see box in Figure 12), we obtain an index of energy associated with eddies in this region (Figure 13).

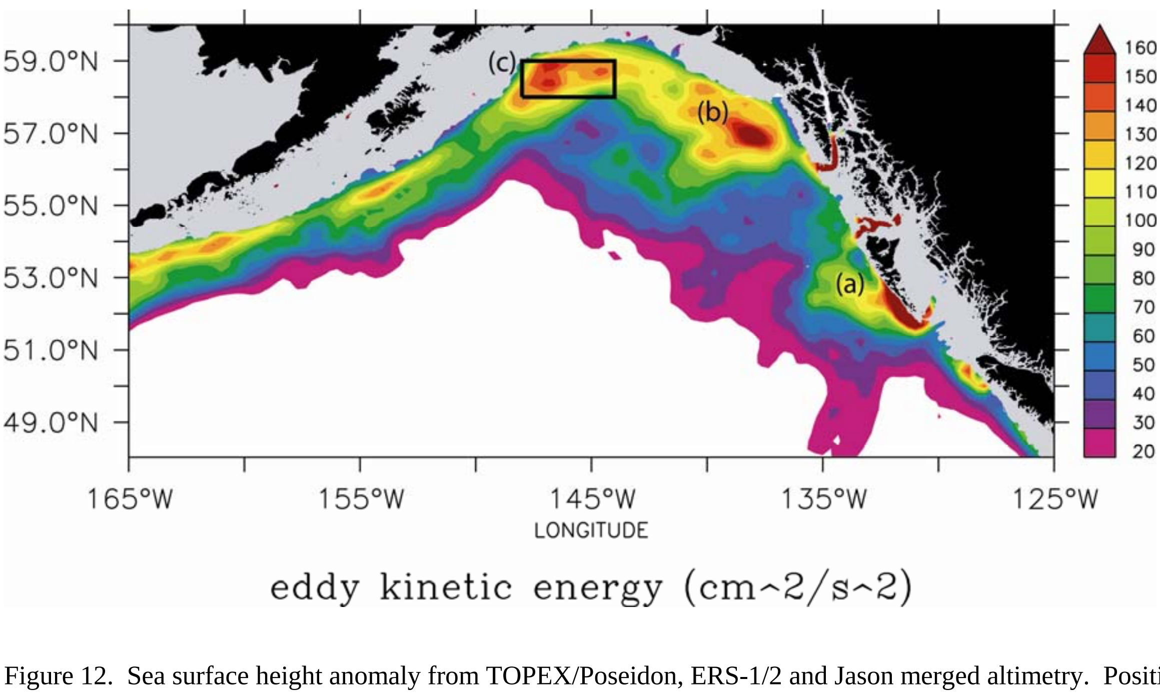

Figure 12. Sea surface height anomaly from TOPEX/Poseidon, ERS-1/2 and Jason merged altimetry. Positive anomalies imply anticyclonic circulation. Black box outlines region over which EKE was averaged for Figure 13.

The seasonal cycle (calculated from the entire time series) of EKE averaged over the box shown in Figure 12 exhibits high EKE in the spring (March – May) with lower EKE in the autumn (September – November). EKE has been high with a stronger seasonal cycle since 1999. Prior to 1999, EKE was generally lower than the ~13-year average, although 1993 and 1997 both showed periods of high EKE. Interestingly, the first 8 months of 2005 showed a return to the low EKE values observed prior to 1999. No significant eddies were observed in this region during the first half of 2005. This may have implications for the ecosystem. Phytoplankton biomass was probably more tightly confined to the shelf during this time period due to the absence of eddies. If fur seals have become dependent on eddies for foraging over the last five years of strong eddy variability, their foraging success may be negatively impacted this year. In addition, cross-shelf transport of heat, salinity and nutrients are likely to be smaller than in previous years with large persistent eddies. Research is ongoing as to the causes and implications of these patterns.

The altimeter products have been produced by the CLS Space Oceanography Division; downloaded from http://www.aviso.oceanobs.com/.

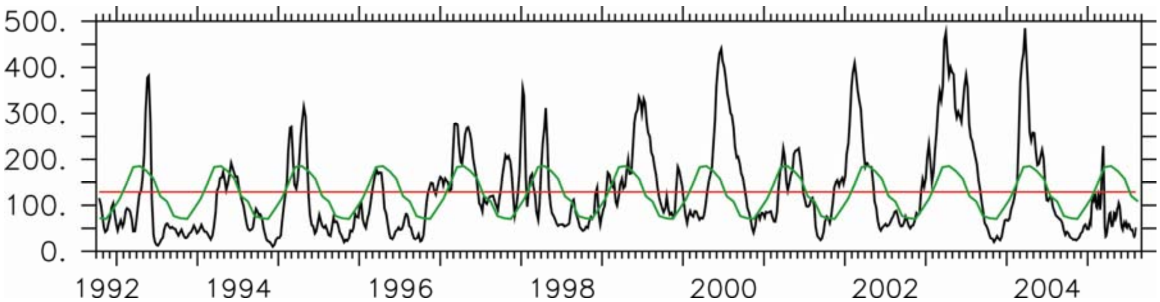

Figure 13. Eddy kinetic energy (EKE) averaged over the region shown in Figure 12 calculated from altimetry. Black: weekly EKE. Red: mean over entire time series. Green: annual cycle.